SEA ICE PREDICTION NETWORK (SIPN)
Template for Pan-Arctic Sea Ice Outlook Core Contributions
August 2015 Report

*REQUIRED

1. *Contributor Name(s)/Group – how you would like your contribution to be labeled in the report (e.g., Wiggins et al.) Yuan et al., LDEO/Columbia University

1b. (Optional but helpful for us): Primary contact if other than lead author; name and organization for all contributors; total # of people who may have contributed to your Outlook, even if not included on the author list. Xiaojun Yuan is the primary contact person. Cuihua Li and Lei Wang, both at Lamont-Doherty Earth Observatory of Columbia University, are the co-authors on this report. There are total 8 people who have contributed to the model developments, methodology of bias corrections, estimation of ice probability and operational forecast.

2. * Individuals submitting "public" contributions should self-identify here:
____x___ Yes, this is a "public" contribution.

3. *"Executive summary" about your Outlook contribution (max 300 words)
Say in a few sentences what your Outlook contribution is and why. To the extent possible, use non-technical language. The prediction is made by statistical models that are capable to predict Arctic sea ice concentrations at grid points 2-month in advance with reasonable skill. The models employ 34 years of monthly time series of sea ice, SST and atmospheric variables. The pan Arctic SIE is calculated from predicted ice concentration and projected to be 5.18 million square kilometers in September 2015. That is lower than the observed extents in 2013 and 2014, but still above the historical low in 2012. The ice concentration is significantly below the 34-year climatology in the Beaufort Sea, Chukchi Sea, East Siberian Sea, Laptev Sea, Kara Sea and Barents Sea.

4. *Type of Outlook projection
___dynamic model __x_statistical ___heuristic ____mixed or other: (specify)

If you use a model, please specify:
Model Name __Linear Markov Models_____
Components of the model: Atmosphere_x_, Ocean_x_, Ice_x_, Land__,
For models lacking an atmosphere or ocean, please describe the forcing: ___

5. *September monthly average projection (extent in million square kilometers. To be consistent with the validating sea ice extent index from NSIDC, if possible please first

compute the average concentration for the month and then compute the extent as the sum of area of all cells > 15%.) 5.18 millions square kilometers.

6. *Short explanation of Outlook method (max 300 words)
In addition, we encourage you to submit a more detailed Outlook, including discussions of uncertainties/probabilities, including any relevant figures, imagery, and references. If this is a model contribution, please include the method of initialization and variable used. A linear Markov model was used to predict monthly Arctic sea ice concentration at all grid points in the pan Arctic region. The model is a stochastic linear inverse model that was built in the multivariate EOF (mEOF) space and is capable of capturing the co-variability in the ocean-sea ice-atmosphere system. The model employs 6 variables (NASA Team sea ice concentration, sea surface temperature (ERSST), surface air temperature, 300mb height and wind vectors at 300mb from NCEP/DOE reanalysis II) and 11 mEOF modes. In addition, we also used a regional Markov model for the Pacific sector of the Arctic, which provides better skills than the pan Arctic model in this region. The regional model was developed in a rotated mEOF space with three variables (sea ice concentration, sea surface temperature and surface air temperature) and 23 modes. The results from the regional model then replaced the predictions from the pan Arctic model in the Pacific region. The merged predictions of sea ice concentration from these two Markov models were used to calculate September SIE prediction and used for predictive skill assessments.

7. Projection uncertainty/probability estimate for September extent (only required if available with the method you are using) The uncertainty of SIE prediction at 2-month lead is measured by RMS errors (RMSE) between predictions and observations. EMSE for 2-month lead September SIE predictions is 0.379 million square kilometers and the model skill measured by an anomaly correlation is 0.91.

8. Short explanation/assessment of basis for the uncertainty estimate in #6 (1-2 sentences) The uncertainty is estimated based on the leave-one-year-out cross-validated model experiments for two-month lead predictions of September ice concentration and total sea ice extent, using 34 years (1979-2012) of time series.